

## **REMARKS**

Claims 1-3, 5-8, 10, 11 and 13-19 are pending in the present Application.

Claims 1 and 10 have been amended to further clarify the alternative specie in the Markush and to correct typographical errors. Claims 1 and 10 have also been amended to recite a brightening agent compound. Support for this is found in the Specification at page 6, lines 27-28. Claims 2, 11 and 14-19 have been amended to correct typographical and grammatical errors.

Claims 1, 10, 13-14, 16-17 and 19 have been objected to because of various minor informalities. Applicants submit that this objection is mooted by the present Amendment and respectfully request that this objection be withdrawn.

Claims 1-3, 5-8, 10-11 and 13-19 have been rejected under 35 USC § 112, second paragraph, as being indefinite for failing to point out particularly and claim distinctly the subject matter which Applicants regard as their invention. Applicants submit that this rejection is made moot by the present Amendment and respectfully request that this rejection be withdrawn.

Claims 1-3, 5-8, 10-11, 13, 15-16 and 18-19 are provisionally rejected under the judicially created doctrine of obviousness type double patenting as being unpatentable over claims 1-8, 11 and 13-43 of copending Application Serial No. 09/970,271 (Cobly et al.). Applicants submit herewith a terminal disclaimer and respectfully request that this rejection be withdrawn.

Claims 1-3, 5-8, 10-11, 13, 15, 16, 18 and 19 have been rejected under 35 USC § 103(a) as being unpatentable over Eckles (U.S. 4,384,930) in combination with Okinaka et al. (U.S. 4,469,564). Applicants respectfully traverse.

Applicants' invention is directed to a copper plating bath, and method using such bath, comprising copper, water, a water-soluble chlorine compound, a brightening agent compound

represented by the formula –X-S-Y-, and a thiol-reactive compound chosen from certain compounds. Thus, Applicants' copper plating bath *requires* both a brightening agent compound and a thiol-reactive compound.

Eckles is directed to an electroplating bath containing at least one surfactant of a given formula, such surfactants providing bright and level metal deposits. Such electroplating bath may contain a brightening compound, and such brightening compounds are typically "carbonyl-containing compounds which may be either aromatic carbonyl-containing compounds or aliphatic carbonyl-containing compounds." Such carbonyl-containing compounds are "aldehydes, ketones and carboxylic acids". See column 5, lines 7-13. This patent does not disclose or suggest brightening agents of the formula –X-S-Y- as required by the present claims. Accordingly, the Eckles patent neither teaches nor suggests the combination of Applicants' brightening agent with a thiol-reactive compound. Since Eckles does not teach or suggest Applicants' brightening compounds, neither does Eckles teach or suggest the problems with such brightening compounds that are solved by Applicants' invention.

The Okinaka et al. patent does not fill the deficiencies of Eckles. This patent discloses a copper electroplating bath containing certain polysulfide compounds. Such polysulfide compounds are disclosed to be ductility increasers. See column 4, lines 50-51 and column 6, lines 3-4. This patent neither teaches nor suggests the use of these polysulfide compounds as brightening agents. Further, this patent fails to recognize the problem of the formation of –X-S<sup>-</sup> compounds resulting from the use of these polysulfide compounds as brightening agents. Such –X-S<sup>-</sup> compounds lead to a deterioration in the via-filling property of the copper plating solution and in the appearance of the plated deposit. See the present Application generally starting at page 7 line 11 through page 9, line 14, and particularly at page 7, lines 11-16. Still further, the Okinaka patent neither discloses nor suggests the use of thiol-reactive compounds, such as aldehydes, in copper electroplating baths. Accordingly, this patent neither teaches nor suggests the use of thiol-reactive compounds with polysulfide compounds.

There is no motivation to combine these references. The Official Action posits that the motivation lies in the fact that the polysulfide compound of Okinaka would increase the ductility of the deposit. Applicants respectfully disagree. There is nothing in Eckles that suggests that

ductility of the metal deposit is lacking or in any way needs to be improved. Further, the polysulfide compounds of Okinaka et al. are also known to be brightening agents. See, e.g. Sonnenberg et al. (US 5,252,196) at column 9, lines 9-33. Thus, if one were to combine Eckles and Okinaka, one would at best use the polysulfide compound of Okinaka as a brightening agent in the bath of Eckles *instead* of the carbonyl-containing compounds. Neither reference alone or in combination teaches or suggests the combination of a polysulfide compound and a thiol-reactive compound, such as an aldehyde. In particular, neither reference alone nor in combination teaches or suggests the reduction of problems in via-filling using a copper plating bath containing a compound of the formula –X-S-Y- by the addition of a thiol-reactive compound to the copper plating bath.

Applicants submit that the Examiner has not made out a prima facie case of obviousness and respectfully request that this rejection be withdrawn.

Claims 14 and 17 have been rejected under 35 USC §103(a) as being unpatentable over Eckles (US 4,384,930) in combination with Okinaka et al. (US 4,469,564) and further in view of Uzoh et al. (US 6,355,153). Applicants respectfully traverse.

Ecklea and Okinaka et al. are discussed above, both individually and in combination.

Uzoh et al. is directed to chip interconnect and packaging methods in which portions of a seed layer are selectively removed from the top surface of a substrate and a conductive material is deposited in the cavities of the substrate. The conductive material is deposited from a plating bath which may contain a metal oxidizing agent. This patent does not fill the deficiencies of Eckles, Okinaka or a combination of these two. Nothing in Uzoh et al. teaches or suggests the use of thiol-reactive compound in the plating bath. Further, nothing in this patent teaches or suggests the combination of a thiol-reactive compound with a compound of the formula –X-S-Y-. Still further, Uzoh et al. neither teach nor suggest the reduction of problems in via-filling using a copper plating bath containing a compound of the formula –X-S-Y- by the addition of a thiol-reactive compound to the copper plating bath. If one were to combine Uzoh et al. with a combination of Okinaka and Eckles, one would at best have a plating bath containing the surfactant of Eckles and the polysulfide compound of Okinaka et al. and the metal oxidizing

agent of Uzoh et al. Nothing in any of these references alone or in any combination teaches or suggests a copper plating bath comprising copper, water, a water-soluble chlorine compound, a brightening agent compound represented by the formula  $-X-S-Y-$ , and a thiol-reactive compound chosen from certain compounds. Applicants submit that the Examiner has not made out a prima facie case of obviousness and respectfully request that this rejection be withdrawn.

Applicants respectfully request favorable reconsideration in the form of a notice of allowance.

Respectfully submitted,

A handwritten signature in black ink, reading "S. Matthew Cairns". The signature is written in a cursive style with a long, sweeping horizontal line extending from the end of the name.

S. Matthew Cairns, Ph.D.  
Attorney for Applicant  
Registration No. 42,378

c/o EDWARDS & ANGELL  
Dike, Bronstein, Roberts & Cushman IP Group  
PO Box 9169  
Boston, MA 02209  
Date: